What is claimed:

1. A bistatic radar system comprising a plurality of transmitters and receivers for transmitting and receiving radar signals, at least one transmitter positioned in a location separated from at least one receiver, each of the plurality of transmitters and receivers including a local oscillator locked to a GPS signal to provide coherency between the plurality of transmitters and receivers.

2. A bistatic radar system according to claim 1, wherein the plurality of transmitters and receivers are configured to detect and measure oceanic conditions, and wherein the bistatic radar system further comprises signal processing means adapted to derive information on the oceanic conditions.

3. A bistatic radar system according to claim 2, wherein the oceanic conditions detected and measured by the plurality of transmitters and receivers includes surface current velocity vectors.

4. A bistatic radar system according to claim 3, wherein the signal processing means is adapted to determine a current velocity (V_h) within a scattering cell using a Doppler shift (f_D) measured using the bistatic radar system, and the following equation:

$$V_h = \frac{f_D \pm \sqrt{\frac{g}{\pi\lambda}\cos\frac{\vartheta}{2}}}{\frac{2}{\lambda}\cos\frac{\vartheta}{2}}$$

where λ is the wavelength of the radar signals; g is the acceleration of gravity (9.806 m/s^2); and ϑ is a bistatic angle between lines connecting the transmitter and the scattering cell and the receiver and the scattering cell.

5. A bistatic radar system according to claim 4, wherein the current velocity (V_h) is determined along a hyperbola perpendicular to an ellipse passing through the scattering cell and confocal about the transmitter and receiver, the ellipse having a constant time delay (D) equal to the measured radar echo time delay.

6. A bistatic radar system according to claim 1, wherein the plurality of transmitters and receivers further comprise at least one co-located transmitter and receiver pair.

7. A bistatic radar system comprising:

a plurality of transmitters and receivers for transmitting and receiving radar signals, the plurality of transmitters and receivers configured to detect and measure oceanic conditions, at least one receiver positioned in a location separated from at least one transmitter; and

signal processing means adapted to derive information on oceanic conditions including surface current velocity vectors from the oceanic conditions detected and measured by the plurality of transmitters and receivers.

8. A bistatic radar system according to claim 7, wherein the signal processing means is adapted to determine a current velocity within a scattering cell using a Doppler shift (f_D) measured using the bistatic radar system, and the following equation:

$$V_h = \frac{f_D \pm \sqrt{\frac{g}{\pi\lambda}\cos\frac{\vartheta}{2}}}{\frac{2}{\lambda}\cos\frac{\vartheta}{2}}$$

where λ is the wavelength of the radar signals; g is the acceleration of gravity (9.806 m/s^2); ϑ is a bistatic angle between lines connecting the transmitter and the scattering cell and the receiver and the scattering cell; and V_h, is the current velocity along a hyperbola passing through the scattering cell.

9. A bistatic radar system according to claim 7, wherein the signal processing means is adapted to calculate a Doppler shift (f_D) using a computer program developed for a backscatter radar system and the following equation:

$$f_D = \pm\sqrt{\frac{g}{\pi\lambda}} + 2\frac{V_r}{\lambda}$$

where λ is the wavelength of the radar signals; g is the acceleration of gravity (9.806 m/s^2); and V_r, is a pseudo-radial current velocity derived in a pseudo backscatter stage using the computer program developed for a backscatter radar system and oceanic

conditions detected and measured by the plurality of transmitters and receivers.

10. A bistatic radar system according to claim 9, wherein the signal processing means is adapted to determine a current velocity (V_h) along a hyperbola passing through a scattering cell using the calculated Doppler shift (f_D) and the following equation:

$$V_h = \frac{f_D \pm \sqrt{\frac{g}{\pi\lambda}\cos\frac{\theta}{2}}}{\frac{2}{\lambda}\cos\frac{\theta}{2}}$$

where λ is the wavelength of the radar signals; g is the acceleration of gravity (9.806 m/s^2); and ϑ is a bistatic angle between lines connecting the transmitter and the scattering cell and the receiver and the scattering cell.

11. A bistatic radar system according to claim 7, wherein the surface current velocity vectors derived from the oceanic conditions detected and measured are independent of motions of waves having velocities over a Doppler spectral region substantially the same as the surface current velocity vectors.

12. A bistatic radar system according to claim 7, wherein the bistatic radar system is adapted to provide total current vectors in regions along a line joining the receiver positioned in a location separated from the transmitter.

13. A method of mapping surface current vectors using a radar system comprising a plurality of transmitters and receivers, including at least one transmitter positioned in a location separated from at least one receiver, the method comprising steps of:

scattering radar signals from the transmitter off waves within a scattering cell to produce echoes in the receiver;

determining a bearing angle (φ) to the scattering cell using a bearing determining algorithm;

sampling versus time after transmission to measure radar echo time delay from the transmitter to the receiver;

determining a position of the scattering cell; and

determining a current velocity at the scattering cell.

14. A method according to claim 13, wherein the step of determining a current velocity at the scattering cell comprises the steps of:

measuring a Doppler shift (f_D) using the at least one transmitter positioned in a location separated from the at least one receiver; and

determining current velocity at the scattering cell using the following equation:

$$V_h = \frac{f_D \pm \sqrt{\frac{g}{\pi\lambda}\cos\frac{\vartheta}{2}}}{\frac{2}{\lambda}\cos\frac{\vartheta}{2}}$$

where λ is the wavelength of the radar signals; g is the acceleration of gravity (9.806 m/s^2); ϑ is a bistatic angle between lines connecting the transmitter and the scattering cell and the receiver and the scattering cell; and V_h, is the current velocity along a hyperbola passing through the scattering cell.

15. A method according to claim 13, wherein the step of determining a current velocity at the scattering cell comprises the step of calculating a Doppler shift (f_D) using a computer program developed for a backscatter radar system and the following equation:

$$f_D = \pm\sqrt{\frac{g}{\pi\lambda}} + 2\frac{V_r}{\lambda}$$

where λ is the wavelength of the radar signals; g is the acceleration of gravity (9.806 m/s^2); and V_r, is a pseudo-radial current velocity derived in a pseudo backscatter step using the computer program developed for a backscatter radar system and information on oceanic conditions detected by the bistatic radar system.

16. A method according to claim 15, wherein the step of determining a current velocity at the scattering cell comprises the step of determining a current velocity (V_h) along a hyperbola passing through the scattering cell using the calculated Doppler shift (f_D) and the following equation:

$$V_h = \frac{f_D \pm \sqrt{\frac{g}{\pi\lambda}\cos\frac{\vartheta}{2}}}{\frac{2}{\lambda}\cos\frac{\vartheta}{2}}$$

where λ is the wavelength of the radar signals; g is the acceleration of gravity (9.806 m/s^2); and ϑ is a bistatic angle between lines connecting the transmitter and the scattering cell and the receiver and the scattering cell.

17. A method according to claim 13, wherein the step of determining a position of the scattering cell comprises the step of:

determining a major axis (A) of an ellipse passing through the scattering cell and confocal about the transmitter and receiver, the ellipse having a constant time delay (D) equal to the measured radar echo time delay;

determining a minor axis (B) of the ellipse;

determining sine and cosine of an angle (Ψ) from the scattering cell to an origin of a local coordinate system; and

determining the position of the scattering cell of the within the local coordinate system from the sine and cosine of the angle and the major and minor axises of the ellipse.

18. A method according to claim 17, wherein the step of determining the major axis comprises using the following equation:

$$A \equiv D + F$$

where F is an interfocal distance separating the transmitter and receiver.

19. A method according to claim 18, wherein the step of determining the minor axis comprises using the following equation:

$$B \equiv \sqrt{D^2 + 2DF}$$

20. A method according to claim 19, wherein the step of determining sine and cosine of Ψ comprises using the following equations:

$$Den \equiv (B \sec\varphi)^2 + (F \tan\varphi)^2$$

and

$$\cos\psi = \frac{-F(F+D)\tan^2\varphi + B^2 \sec\varphi}{Den}$$

21. A method according to claim 13, wherein the step of determining the bearing angle (φ) to the scattering cell comprises the step of determining the bearing angle (φ) to the scattering cell using a MUltiple SIgnal Classification (MUSIC) direction-finding algorithm.

22. A computer program product for use in conjunction with a computer system, the computer program product comprising a computer readable storage medium and a computer program mechanism embedded therein, the computer program mechanism, comprising:

a program module that directs the computer system, to function in a specified manner, to map surface current vectors using a radar system comprising a plurality of transmitters and receivers, including at least one transmitter positioned in a location separated from at least one receiver, the program module including program code for:

scattering radar signals from the transmitter off waves within a scattering cell to produce echoes in the receiver;

determining a bearing angle (φ) to the scattering cell using a bearing determining algorithm;

sampling versus time after transmission to measure radar echo time delay from the transmitter to the receiver;

determining a position of the scattering cell; and

determining a current velocity at the scattering cell.

23. A computer program product according to claim 22, wherein the program code for determining a current velocity at the scattering cell comprises program code for:

determining a Doppler shift (f_D) of the echoes; and

calculating current velocity using the following equation:

$$V_h = \frac{f_D \pm \sqrt{\frac{g}{\pi\lambda}\cos\frac{\vartheta}{2}}}{\frac{2}{\lambda}\cos\frac{\vartheta}{2}}$$

where λ is the wavelength of the radar signals; g is the acceleration of gravity (9.806 m/s^2); ϑ is a bistatic angle between lines connecting the transmitter and the

scattering cell and the receiver and the scattering cell; and V_h, is the current velocity along a hyperbola passing through the scattering cell.

24. A computer program product according to claim 23, wherein the program code for determining the Doppler shift (f_D) of the echoes comprises program code for measuring the Doppler shift using the at least one transmitter positioned in a location separated from the receiver.

25. A computer program product according to claim 23, wherein the program code for determining the Doppler shift (f_D) of the echo comprises program code for calculating the Doppler shift (f_D) using the following equation:

$$f_D = \pm\sqrt{\frac{g}{\pi\lambda}} + 2\frac{V_r}{\lambda}$$

where λ is the wavelength of the radar signals; g is the acceleration of gravity (9.806 m/s^2); and V_r, is a pseudo-radial current velocity derived in a pseudo backscatter stage using the computer program developed for a backscatter radar system and oceanic conditions detected and measured by the plurality of transmitters and receivers.